

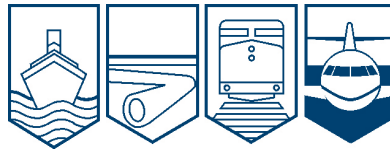
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A10W0040



RUNWAY INCURSION

NAV CANADA

CALGARY INTERNATIONAL AIRPORT, ALBERTA

02 MARCH 2010

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

Runway Incursion

NAV CANADA

Calgary Tower

Calgary International Airport, Alberta

02 March 2010

Report Number A10W0040

Summary

The Calgary International Airport was operating under its reduced visibility operations plan with runway 16 as the only active runway. The runway visual range (RVR) for runway 16 was variable, from 1400 to 4000 feet, for most of the morning. There were 12 aircraft lined up for departure from the threshold, 2 from taxiway C4 and 1 from taxiway U at mid field. After a BAE 125-800A (registration C-GMTR, serial number NA0435), operating as flight CNK744, commenced its take-off roll from the threshold, a de Havilland DHC-8-102 (registration C-FCWP, serial number 111), operating as flight NCB801, was instructed to line up and wait at the threshold of runway 16. NCB801 was the aircraft at Taxiway U. At 0945 Mountain Standard Time, after NCB801 queried the instruction, the airport controller confirmed it and advised NCB801 to be ready for an immediate take-off. NCB801 crossed the hold line at taxiway U as CNK744 passed overhead, climbing to 400 feet above ground level (agl).

Ce rapport est également disponible en français.

Other Factual Information

History of Flight

The weather, as described by the 0900¹ METAR,² included wind 120° true at 4 knots, visibility of ½ statute mile in light snow grains and freezing fog, ceiling of 200 feet above ground level (agl) broken, 500 feet agl overcast, temperature of 4°C and dew point of 7°C. The reported runway visual range³ for runway 16 was 2000 feet. A special observation taken at 0943 reported substantially the same weather, with an RVR of 2200 feet. At 1000, the RVR was down to 1600 feet.

The North Cariboo Flying Services Ltd. DHC-8-102, flight NCB801, was conducting a charter flight from Calgary to Edmonton, Alberta, under the authority of an operations certificate issued under subpart 705 of the *Canadian Aviation Regulations* (CARs). NCB801 departed the North Cariboo hangar on apron V at 0900, was authorized to taxi on taxiway N and hold short of taxiway C on runway 25 (see Appendix A - Calgary International Airport Aerodrome Chart). NCB801 held in that position for seven minutes. At 0904, the ground controller made a special broadcast to all aircraft taxiing for departure to be patient, that their positions were known and to stand by for further instructions.⁴ At approximately 0910, NCB801 was authorized to continue taxiing north on taxiway C towards runway 16 and to hold short of the runway on taxiway U. At 0912, the occurrence airport controller received a handoff briefing from the relieved airport controller and was informed that a North Cariboo King Air, flight NCB236, was holding at taxiway U in order to cross runway 16 and depart at taxiway A1 on the west side.

At 0919, NCB236 was cleared to cross runway 16, and subsequently departed from taxiway A1 at 0932. At 0936, the airport controller advised the next five departing aircraft of their sequence for departure, CNK744 being third and NCB801 being fourth. This

Extended Computer Display System (EXCDS) is an advanced tower, terminal, airport and en route coordination system that permits controllers to manage electronic flight data online, using touch sensitive display screens. EXCDS automates flight data transactions, eliminating the need for paper handling, reducing voice communications and minimizing head down time. EXCDS will also display current airport conditions (for example, wind, altimeter, RVR, runway light brightness and active runways). Use of EXCDS at Calgary has resulted in a nearly paper-free environment, where paper strips are used as a backup only and most coordination tasks are automated. The EXCDS also gathers data for billing and statistical purposes. An EXCDS flight strip can track more than 110 different data items (for example, time of departure, aircraft type, destination, and parking gate).

¹ All times are Mountain Standard Time (Coordinated Universal Time minus seven hours).

² METAR – aviation routine weather report.

³ Runway visual range (RVR) – a computed distance expressed in hundreds of feet to inform pilots of the visibility in the landing zone of a runway.

⁴ The number of traffic movements for the hour, before the hour of and the hour after the occurrence was 39, 46 and 39, respectively. The maximum number of movements allowed by the reduced visibility operations plan (RVOP) is 56 per hour.

communication excluded location information of the departures.

At 0940, the airport controller determined that two aircraft could depart between an arriving jet and an arriving turboprop. At 0942, a Sunwest Aviation Ltd. BAE 125-800, flight CNK744, was instructed to line up and wait at the threshold of runway 16. Thirty seconds later, CNK744 was cleared for take-off. Six seconds after CNK744 was cleared for take-off, the airport controller instructed NCB801 to line up, wait at the threshold of runway 16 and turn right, heading 193° magnetic (M) after take-off. NCB801 acknowledged the heading change and began to taxi slowly towards the hold line. The crew did not hear the controller's reference to lining up at the threshold, and did not indicate that they were at taxiway U.

As required by tower procedures, the flight data entry on the EXCDS display representing NCB801 indicated that the aircraft would take off runway 16 from the taxiway U intersection (see Appendix B - EXCDS Display). However, the airport controller did not refer to the EXCDS display.

While the first officer was completing the before take-off checklist, the NCB801 captain asked about the clearance and expressed concern about the recent take-off clearance given to an aircraft at the threshold. By this time, CNK744 was accelerating through 85 knots and passing taxiway C6; NCB801 had yet to cross the hold line.

At 0944, the first officer of NCB801 queried the airport controller to confirm that the tower hadn't authorized anyone's departure. The airport controller restated the instruction to line up, adding that they should be ready for an immediate departure. The airport controller was watching the airport surface detection equipment (ASDE) display for the taxiway C8 area, at the threshold of runway 16, to determine whether NCB801 was moving. The ASDE target in that position was not tagged with a call sign and was not moving. No other ASDE targets taxiing for departure had call sign tags (see Appendix C - ASDE Display at 0943:49). CNK744 was now airborne by taxiway C4, accelerating through 134 knots at approximately 2900 feet north of taxiway U.

Ten seconds after getting the second instruction to line up and wait, NCB801 crossed the hold line and entered runway 16. The airport controller noticed an ASDE target moving in the vicinity of taxiway U and realized that it was NCB801. CNK744 was now over taxiway U, climbing through 400 feet agl. Visibility was low enough to preclude the airport controller from visually seeing either aircraft or the runway. At 0944:35, NCB801 was cleared for take-off from taxiway U.

Flight Crew of NCB801

Records indicate that the flight crew was certified and qualified for the flight, in accordance with existing regulations. Both flight crew members work/rest schedules were such that fatigue would not be considered a factor in this occurrence.

The captain and first officer had received crew resource management training through the company in October and June 2009, respectively. This training included information on human

factors, safety management systems, safety culture, stress and fatigue management, clear communication characteristics, threat error management and error detection.

Having not been disabled, the cockpit voice recorder (CVR) for NCB801 was overwritten, as the aircraft was airborne for more than 30 minutes after departure.⁵

Flight Crew and ATC Communication

Section 602.31 of the CARs states that the pilot-in-command is to “comply with and acknowledge [...] all of the air traffic control [(ATC)] instructions⁶ directed to and received by the pilot-in-command.” Additionally, during instrument flight rules (IFR) flights, the pilot-in-command is to “read back [...] the text of any [ATC] clearance⁷ received.”

Section 336.2 (b) of the *ATC Manual of Operations* (MANOPS) states, in part, that a controller shall state the threshold as the runway entry point when another entry point for the same runway is in use. The controller complied with Section 336.2 (b) when NCB801 was instructed to line up and wait at the threshold of runway 16. The flight crew was not obligated by regulation to read back the instruction, but to acknowledge it, which they did.

Section 4.2.5 of the Transport Canada *Aeronautical Information Manual* (TP14371) advises that, while acknowledging ATC instructions without a full read back is compliant with section 602.31 of the CARs, it is good operating practice to read back instructions to enter, cross, backtrack or line up on any runway.

The International Civil Aviation Organization (ICAO) *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM)⁸ indicates, in part, that the flight crew shall read back to the air traffic controller safety-related parts of ATC clearances and instructions, which are transmitted by voice. These include clearances and instructions to enter, land on, take off from, hold short of, cross, taxi and backtrack on any runway.

Calgary International Airport

The Calgary International Airport possesses an airport certificate issued by Transport Canada. The airport consists of three runways, numerous taxiways and eight aprons. In 2009, the airport was the third busiest in Canada, with 233 145 aircraft movements⁹ and approximately 12 million passengers. NAV CANADA describes it as a complex environment due to the multiple crossing runways (see Appendix A - Calgary International Airport Aerodrome Chart). The other major airports in Canada that have similar traffic movements (Vancouver, Toronto

⁵ The CVR installed in NCB801 had a recording duration of 30 minutes.

⁶ ATC instruction is a directive issued by an ATC unit for ATC purposes.

⁷ ATC clearance is an authorization issued by an ATC unit for an aircraft to proceed within controlled airspace in accordance with the conditions specified by that unit.

⁸ ICAO PANS-ATM Doc 4444, Chapter 4.5.7.5.1.

⁹ A movement is generally a takeoff or a landing.

and Montreal) benefit from parallel runway layouts. Construction of a parallel north/south runway in Calgary will commence in 2011, with a projected in-service date of June 2014.

Low and Reduced Visibility Operations

In 2006, Transport Canada issued the Commercial and Business Aviation Advisory Circular (CBAAC) 0256 which informed CAR 703, 704 and 705 aircraft operators of airport requirements respecting departures under reduced (2600 to 1200 RVR) and low visibility (less than 1200 RVR) weather conditions. The circular referred to many of the standards and recommendations that are published in Transport Canada's *Aerodrome Standards and Recommended Practices* (TP312, 4th Edition) and noted that not all airports were in full compliance.

In March 2008, Transport Canada published Advisory Circular 302-001, which provided information and guidance to airports on the certification and minimum standards required to allow departures and aircraft manoeuvring below an RVR of 2600.

The Calgary International Airport met all of the standards to allow departures down to 1200 RVR, other than guard lights not being installed on all runway and taxiway intersections. On 22 October 2008, the Calgary Airport Authority (CAA) applied for an exemption to Standards 5.3.20.1 and 8.5.1.13 of TP312, along with its Reduced Visibility Operations Plan (RVOP) and hazard identification review. An exemption was granted by Transport Canada on 04 November 2008. By the end of 2009, all the required runway guard lights, as per TP312, had been installed. This ended the requirement for the exemption and for the RVOP; however, for safety reasons, the CAA kept the RVOP as part of its low visibility operations procedures.

The following is a list of some relevant statements from the Calgary RVOP:

- only runways 16 and 34 are available for take-offs and landings;
- all approach lighting, runway edge lighting, runway guard lights and taxi lighting must be functional;
- runway visual range sensors must be operational;
- airport surface detection equipment (ASDE) should be operational and should be the primary reference for NAV CANADA to provide separation between aircraft and vehicles being controlled on the manoeuvring areas. ATC may terminate the RVOP if the ASDE fails; and
- maximum movement rate of 56 aircraft per hour (28 arrivals, 28 departures).

The Hazard Identification and Risk Assessment (HIRA)¹⁰ that was completed in support of the development of the RVOP identified the ASDE as a required mitigation tool to address the risk of aircraft inadvertently entering the active runway while taxiing or colliding with essential vehicles on the manoeuvring areas. There are no restrictions on the use of intersection departures during reduced visibility operations.

¹⁰ The Calgary Airport Authority, several operators and NAV CANADA participated in the assessment.

NAV CANADA Calgary Tower Operations

Air traffic services are provided 24 hours a day by NAV CANADA at the Calgary International Airport. The tower provides air traffic services (ATS) within the 7-mile Class C airspace control zone, extending from the surface to 3000 feet agl.

During the day, the Calgary tower normally has a complement of six controllers and one supervisor. This is sufficient personnel to staff five positions (airport, north ground, south ground, clearance delivery and tower coordinators) and allow for breaks. On the day of the occurrence, the tower was short two personnel, resulting in only three positions being open:

- airport;
- combined ground (north and south); and
- clearance delivery.

Forty minutes before the occurrence, a controller who was doing administrative work on the premises, was called up to the tower cab to assist. This controller was put into the second ground controller position. Positions occupied at the time of the occurrence were clearance delivery, north ground and south ground, while the supervisor occupied the airport controller position. The tower coordinator position was vacant. The controller workload was assessed as medium and complex, given the visibility conditions and the numerous aircraft taxiing for departure.

Calgary tower coordinator – The role of the coordinator is to assist the tower controller in providing a safe and efficient operation. This is accomplished by coordinating with all concerned ATC units, sectors, positions and agencies, and by conducting a variety of tasks. These include EXCDS functions, monitoring the ASDE and the NAV CANADA Auxiliary Radar Display System (NARDS) as well as coordinating and initiating reduced visibility operations. The coordinator typically is seated next to the tower controller and monitors the tower frequency.

Controller

The airport controller was certified and licensed, in accordance with regulations, and had 21 years controlling experience of which 16 were in the Calgary tower. In the three weeks leading up to the occurrence, the controller's work schedule consisted of four days off/six days on, two days off/six days on, and one day off/three days on. Of those 15 work days, 3 were overtime shifts on scheduled days off. The last three days consisted of retrograde shifts that started earlier each day. On the day of the occurrence, the controller started this shift at 0615 and had been on duty for 3.5 hours. It could not be determined how long the airport controller had been working at the position since the last break.

Due to the low visibility, the controller's work concentrated on checking the ASDE display instead of looking outside to determine the aircraft position. Because no aircraft identification information was associated with the ASDE for departing aircraft targets, the controller would normally use the EXCDS display to determine sequence and runway location for departures. For airborne arrivals and departures, a secondary surveillance radar display was used to provide ATS within the control zone. A fourth display representing weather was also configured for the position.

Airport Surface Detection Equipment

The Calgary International Airport is equipped with an ASDE (surface movement radar) that provides a real time display in the tower of aircraft and other vehicle traffic operating on airport manoeuvring areas. According to the ATC MANOPS, controllers should use the ASDE to improve visual observation of traffic operating on the manoeuvring area by referring to ASDE at night, when visibility is restricted or, when in the controller's opinion, an operational advantage will be gained. ATC MANOPS notes that visual scanning is considered the primary technique and permits the ASDE to be used to confirm compliance with control instructions.

The ASDE was installed and the systems acceptance testing completed in September 2003. Version 5.2.2 of the software was installed on 12 August 2009. The software features a runway incursion monitoring and collision avoidance system (RIMCAS). RIMCAS is a software package designed to monitor movements on an airport surface and neighbouring airspace in order to detect and identify possible conflict situations involving aircraft and other objects on pre-defined areas of the airport surface. It also has the ability to produce an alarm when an aircraft crosses a designated virtual stop bar for taxiways and runways (see Appendix C - ASDE Display at 0943:49) or designated restricted areas.

The operations at the Calgary International Airport, with multiple intersecting runways and simultaneous runway operations, produced multiple RIMCAS alarms per hour. These were considered more of a nuisance than an alerting system. None of the RIMCAS features were active at the time of the occurrence. While developing the RVOP, activation of RIMCAS during single runway reduced visibility operations was not considered.

Seeing that the source of information for ASDE is primary radar and that aircraft transponders are not an input, the ASDE software does not provide aircraft identification. Although the targets produced by ASDE on the display can be manually tagged with information by the controller, this tag can inadvertently be swapped with another aircraft taxiing in close proximity or even with stationary objects. Due to this potential for confusion and the requirement for constant monitoring, none of the ground targets had tags to identify each aircraft. The only exception is for arriving aircraft, whose tag is generated with the ASDE by an EXCDS interface, which is displayed when the aircraft descends below 300 feet agl.

In March and April 2007, NAV CANADA conducted both a national and a Calgary International Airport HIRA on ASDE. Both HIRAs identified the ASDE's inability to positively identify targets on the airport. The HIRA for Calgary did not identify a mitigation strategy, whereas the national HIRA identified upgrading to an advanced surface movement guidance system by adopting cooperative sensors and transponders to all mobiles (vehicles and aircraft).

As a result of the TSB investigation into occurrence A07O0305, a Board Concern regarding the limitations of ASDE and the RIMCAS was issued, stating that:

It is, however, unclear whether even an improved ASDE/RIMCAS can significantly reduce the risk of runway incursions and their potentially catastrophic outcomes. The improved system will continue to rely on the interpretation of warnings by controllers and their subsequent radio communication with aircraft and vehicles. The provision of

warnings directly to flight crews provided the impetus for the current testing and introduction of the runway status light (RWSL) system by the Federal Aviation Administration at some airports in the United States.

However, the need for such a system to supplement ASDE/RIMCAS has not been recognized by either Transport Canada or NAV CANADA. The Board is therefore concerned that until flight crews in aircraft that are taking off or landing receive direct warnings of incursions onto the runway they are using, the risk of high-speed collisions will remain.

Runway Incursion Prevention Initiatives

On 16 March 2010, the TSB issued its Watchlist, which identifies the safety issues it investigated that pose the greatest risk to Canadians. One of the issues identified was the risk of collisions on runways. There is ongoing risk that aircraft may collide with vehicles or other aircraft on the ground at Canadian airports. In a 10-year period, from 1999 to 2008, there were 3831 of these conflicts nationwide, known as runway incursions. Given the millions of take-offs and landings each year, incursions are relatively rare; however, the consequences can be catastrophic.

A partial listing of prevention initiatives is found in Appendix D - Runway Incursion Prevention Initiatives.

Analysis

Pilot and Controller Communication

As a result of the long delay between arriving at taxiway U and issuance of the take-off clearance, the airport controller lost track of the location of NCB801 and did not use EXCDS to support or contradict the airport controller's mental model.

The controller believed NCB801 to be at the threshold of runway 16 (taxiway C8) and the flight crew believed the controller knew they were at taxiway U. It is likely that, as a result of the unexpected clearance of two flights between arriving flights, the flight crew of NCB801 felt rushed to get into position and simultaneously unsettled by their take-off clearance that appeared to be sequenced much more quickly than previous departures. The assimilation of the departure heading instruction, the completion of the before take-off check list and the concern about a possible aircraft departing from the threshold all contributed to a high workload for the flight crew of NCB801. This would have resulted in little reserve to figure out that ATC believed them to be at taxiway C8, as opposed to taxiway U. Similarly, the airport controller did not have enough verbal information from the flight crew's query to alter the assumption of NCB801's position before reiterating the instruction to line up.

CARs do not require flight crews to read back the location for line up or take-off instructions. During times of restricted visibility, when an aircraft cannot be positively identified visually, the primary tool for a controller to identify it and its location is through pilot and controller

communications. To ensure that the information is received by the pilot and understood, a read back and hear back must be done.

Calgary Tower Staffing Levels

During the day, the normal complement in the tower was six controllers plus a supervisor. Due to the absence of two controllers, there was insufficient staff to cover all five controlling positions and allow for breaks. As a result, the supervisor took a controlling position, while the tower coordinator position was left vacant. Due to the complexity of the situation and the volume of traffic waiting for departure, this was done in favour of opening the second ground position.

Seeing as the tower coordinator position was vacant, there was one less opportunity to correct the airport controller's misconception regarding the position of NCB801.

ASDE and RIMCAS

The ASDE installed at the Calgary International Airport worked as designed. Due to reduced visibility on the day of the occurrence, the ASDE display was the primary source of information for controlling aircraft that were on the manoeuvring areas. However, the Calgary ASDE does not have aircraft identification tags to differentiate one target from another. Consequently, the controller's ability to acquire and maintain an accurate picture of the departure situation was impeded.

The controller formulated a mental picture as to the position of the next five departing aircraft, based on incomplete information provided on the ASDE display and the flight data entries on the EXCDS display. Although NCB801 was identified at taxiway U on the EXCDS display, the information presented was not used by the controller to either support or contradict the controller's mental model. At the time of the occurrence, the controller's attention was directed towards the ASDE display while waiting for movement of the targeted flight to confirm that the flight was making appropriate and timely movement towards its take-off position. The ASDE target's lack of movement at the threshold of runway 16 ultimately triggered the controller to identify the true location of the aircraft at taxiway U.

The RIMCAS was disabled due to nuisance alarms associated with the configuration of the multiple intersecting runways at the Calgary International Airport. However, when the RVOP was active, only one runway was allowed for arrivals and departures. There was a missed opportunity for RIMCAS to be configured for single runway operations in order to provide another layer of defence against collisions in low visibility conditions.

Reduced Visibility Operations Plan

Intersection take-offs were being allowed to facilitate the movement of aircraft from the apron to runway 16, given its close proximity to the threshold of runway 16. The Calgary International Airport RVOP allowed for such operations when the ASDE was working. However, given the

limitations of the ASDE, this defence was built upon a technological solution that was limited in preventing incursions and, with the RIMCAS disabled, collisions.

Runaway Incursion Prevention Initiatives

Given the risk posed to Canadians by runway incursions and, notwithstanding the progress that has been made to date, this reports again highlights the pressing need for improvement, as emphasized by the Transportation Safety Board in its 2010 Watchlist.

Findings as to Causes and Contributing Factors

1. As a result of the long delay between arriving at taxiway U and the issuance of the take-off clearance, the airport controller lost track of the location of NCB801 and did not use the information presented on the EXCDS to either support or contradict the airport controller's mental model.
2. In its communications with the tower, NCB801 flight crew did not hear the controller's instruction to line up at the threshold and did not include their location information, resulting in the airport controller maintaining the perception that NCB801 was at the threshold.
3. The tower was operating at reduced staffing levels, with the tower coordinator position vacant, resulting in one less opportunity to correct the controller's perception of where NCB801 was on the field.
4. The ASDE display does not show the identification tags of departing aircraft, allowing the controller to continue with the mistaken belief that NCB801 was at the threshold rather than at taxiway U.
5. The RIMCAS feature was not enabled, thus removing an opportunity for the controller to be alerted to NCB801 crossing the hold line while CNK744 was becoming airborne.
6. The RVOP allowed for multiple intersection take-offs with a less than adequate defence (that is, ASDE) to mitigate the risk of runway incursions.

Finding as to Risk

1. Seeing that the CARs do not require flight crews to read back their location when acknowledging instructions to enter an active runway, there is a risk of runway incursions, as controllers are unable to confirm aircraft position and flight crew understanding of the instruction.

Safety Action Taken

NAV CANADA

On 03 March 2010, Operations Letter 10-004 was issued by the NAV CANADA site manager for the Calgary tower. The letter stated, in part, that the following procedures would be implemented immediately:

“While RVOP is in effect, no aircraft shall depart from any intersection along a runway unless the tower coordinator position is opened and manned. ”

In addition, the tower operations committee has been tasked with reviewing the use of intersection departures during RVOP.

On 09 October 2010, Operations Letter 10-015 was issued by the NAV CANADA site manager for the Calgary tower to replace Operations Letter 10-004. The letter advised that the Operations Committee had reviewed the use of intersection departures during RVOP and had agreed to discontinue the practice unless the tower coordinator position was manned. This directive is now permanent.

The virtual stop bar feature in the ASDE system at the Calgary control tower is being put into use for reduced visibility operations. Software updates, system testing and controller training are to be completed by mid November 2010.

North Cariboo Flying Services Ltd.

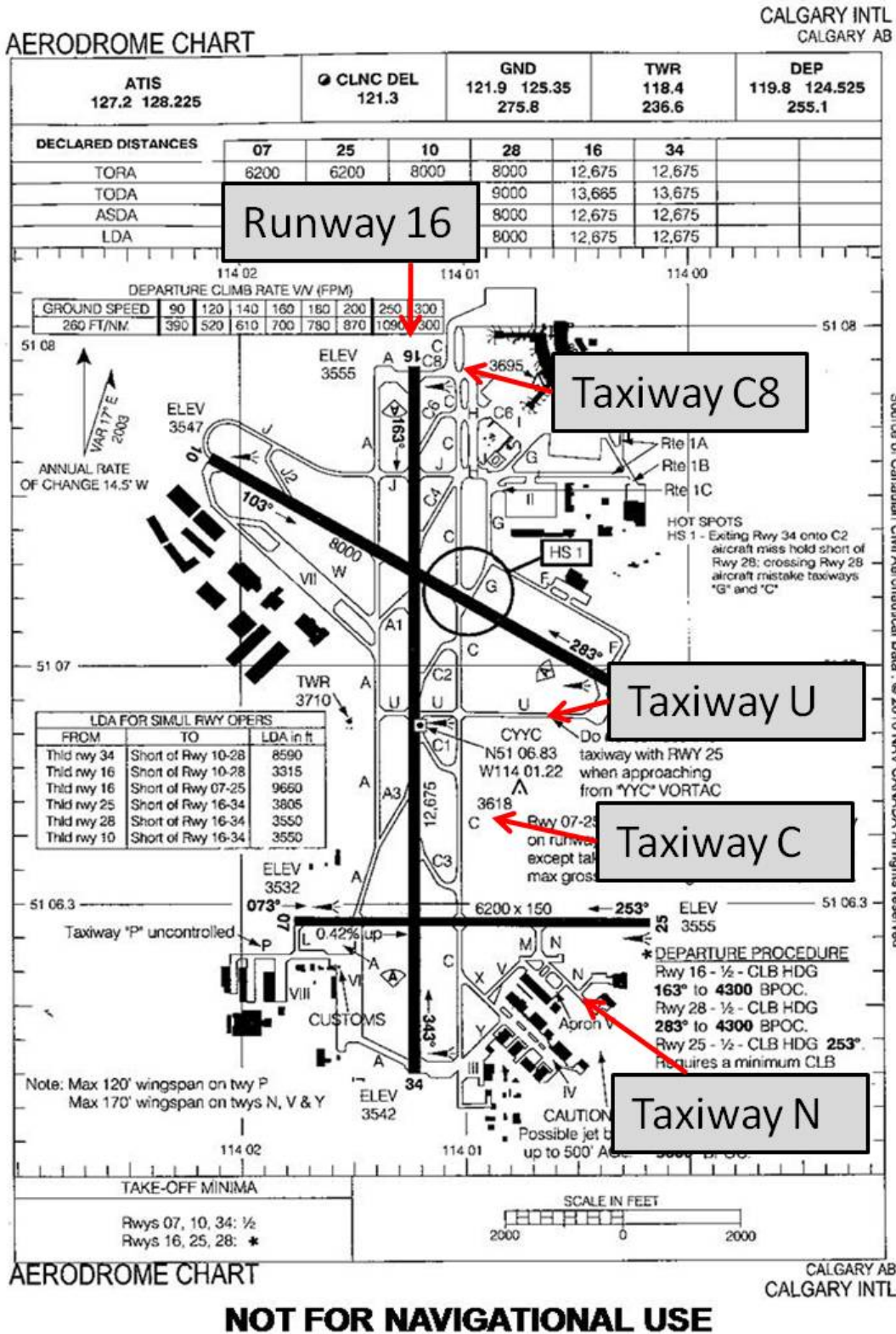
North Cariboo Flying Service Ltd. issued a Flight Operations Bulletin for its operations conducted under subparts 703, 704 and 705 of the CARs stating that “Effectively immediately North Cariboo Air will be applying full length departures from all runways when LVOP or RVOP operations in [e]ffect.”

Additionally, the following will be incorporated into the company operations manual:

Communicating with Tower/Radio: When holding short, regardless of frequency congestion or position crew will state their position on the field (for example, “NCB 801 holding short Runway 16 on Uniform”). This includes hand over to Tower from Ground frequency, this ensures Flight Crew and ATC are working together to keep situational awareness.

This report concludes the Transportation Safety Board’s investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 October 2010.

Appendix A – Calgary International Airport Aerodrome Chart



Appendix B - EXCDS Display

EXCDS Workstation Version 3.10 (EG_EXCDS_DML_B) [C:\EXCDS3\ycwks.dll]

Help

TOWER VR NoFlow SFO 0400 **120/03** *2977*

FREQS ACK LOCAL EDIT

MODE RWY 16 SPEED 160 NO AUTOS 16/34 No LAHSO 10/28 CLOSED NO BIA RPT GSORT OFF TURNS ON RESTR OFF VISDP ON

Sequenced Arrivals 4 NEW

Return Cancel FR Taxied Toggle Delete Undelete

MA	N822DS	16	HS	KGEG	GND
M/C680/W					
MA	NRL920	16	HS	KBFI	GND
M/CVLT/G					
MA	WJA150	16	HS	CYVR	GND
M/B737/W				GLR784	MA M/B190/G 16

Local 0 Activate Clear Return Enroute Enroute

MA	ACA122	16	HS	HUS	VD	Hide	CS
M/A320/				1638		1b : TCAS	
MA	WJA165	16	HS	WES	VD	Hide	CS
M/B737/				1640		4c : TCAS	
MA	CNK744	16	W	CYXC	VD	Hide	CS
M/H25B/				1643		YVC	WJA567 6331 M/B

Taxied Dep	18	RODS	25	RODS	28	RODS	34	RODS	DEL	ALL RODS	DEL
NCB801	4660	M/DH8A	NC	193	U	283	CYEG	1600	GELLE GEL	F140	VD CS
JZA301	1744	M/CRJ2	NC	16		426	KSEA	1645	TURNY YX	340 : TCAS EQI	VD CS
DAL2126	1320	M/A319/	NC	16		440	KMSP	1500	J504 YEA Y	390 1b : TCAS t	VD CS
UAL431	1361	M/A320/	NC	16		443	KDEN	1535	DARWIN J47	390 :	VD CS
JZA393	3347	M/CRJ2	NC	16		403	CYLW	1600	YYC J508 S	340 : TCAS EQI	VD CS
SKW6389	2166	M/CRJ7	NC	16		439	KSFO	1600	YYC J637 R	360 2b :	VD CS
WJA110	3325	M/B736/	NC	16		442	CYQR	1630	HUSAR J60	410 1b : TCAS t	VD CS
WJA1476	1334	M/B737/	NC	16		442	KLAS	1616	DARWIN DL	390 2b-30SECT	VD CS

Appendix C – ASDE Display at 0943:49



NOTES:

Only arriving aircraft have tags that correlate to their flight information, due to the secondary surveillance radar system having correlated the target with the aircraft's mode 'C' or mode 'S' transponder.

The three digit number in the black tag for the ASDE target represents ground speed.

It is unknown what the 362 associated with NCB801 means.

Appendix D - Runway Incursion Prevention Initiatives

2000 - Transport Canada/NAV CANADA Sub-committee on Runway Incursions (SCRI). Twenty recommendations were recorded in document TP13795E. Two relevant recommendations and actions taken are listed below:

4.7 Transport Canada work in collaboration with ATS service providers to develop a policy regarding runway intersection departures. The intent of this policy should be to minimize or, when practicable, eliminate the use of intersection departures. NAV CANADA responded with the requirement of ATC to issue the intersection name when aircraft are authorized to taxi to position and wait in addition to being provided with take-off clearances.

4.22 Transport Canada, working in partnership with NAV CANADA, the airport authority and local stakeholders, conduct an in-depth study of the runway incursion risk at Calgary International Airport and assess the adequacy of existing and future preventive measures.

2001 - Runway incursion prevention action team (IPAT) is assembled as a result of the SCRI report. The team is comprised of NAV CANADA and Transport Canada.

2005 - IPAT disbanded.

2006 - Runway Safety and Incursion Prevention Panel (RSIPP) is activated and includes a multidisciplinary team from industry and government.

2007 - Manual on the Prevention of Runway Incursions, ICAO, doc. 9870.

2008 - IATA Safety Trend Evaluation, Analysis and Data Exchange - Runway Incursions.

2008 - Air Traffic Services - Pilot Communications Working Group - to raise awareness of the importance of employing best practices in controller-pilot communications.

2010 - TSB inclusion of runway incursions in the TSB Watchlist.

Safety Action Taken in Canada Since 2000

The following is a partial list of some safety action that has been taken nationally, as a result of the above initiatives:

- NAV CANADA internal awareness campaign.
- Adoption, by TC and NAV CANADA, of a common definition of an incursion and severity ranking for occurrence analysis.
- Authorization from ATS required to cross all runways.

- Line up and wait phraseology to meet ICAO requirements.
- Availability of airport diagrams on the NAV CANADA website.
- Several articles on runway incursions in the Transport Canada Aviation Safety News Letter.
- Runway incursion web page on the NAV CANADA website.

The following is a partial list of some safety action that has been taken at the Calgary International Airport since 2000:

- Enhanced runway markings using black underlay, applied below paint, to enhance contrast and visibility.
- Dedicated taxi chart for aircraft operating to and from apron I (main terminal).
- Identification of high incursion risk location (hot spot) on aerodrome chart.
- The reconfiguration of C2 to reduce inadvertent entry onto runway 34 from taxiway C.
- The upgrade of ASDE.
- The upgrade of airport lighting to meet TP312 standards for reduced visibility operations.
- The addition of a second ground frequency.
- Commencement of discussions with the CAA for the installation of multilateration technology to improve surveillance of vehicles and aircraft on the airport.